Name
DOB
Affix Patient Identity Label
HOSP NO
NHS NUMBER

Diabetic Ketoacidosis in Children

Integrated Care Pathway

3rd Edition

Date of Publication: March 2016

To be reviewed in September 2020

2nd Edition: May 2010; Amended July 2014

1st Edition: June 2007

This integrated care pathway for the management of ketoacidosis in children with diabetes has been jointly developed by the paediatric departments at the Princess of Wales Hospital, Bridgend and the Paediatric Diabetes Service, Bristol Royal Hospital for Sick Children. The patient management outlined in the care pathway is based on the updated NICE guidance (2015) and recommended by the British Society for Paediatric Endocrinology and Diabetes (2015). The integrated care pathway has been reviewed and endorsed by the Children & Young People's Wales Diabetes Network (& Brecon Group).

Any comments or suggestions may be addressed to

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Integrated Care Pathway: Diabetic Ketoacidosis

When to use this Integrated Care Pathway (ICP)

This ICP is intended for the management of children with either an established or new diagnosis of Type 1 Diabetes Mellitus and presenting with ketoacidosis. **If complications such as cerebral oedema occur during the course of management or the child requires admission to the intensive care unit for any other reason, the use of this ICP should be terminated.** It is essential to inform the Paediatric Registrar on call as soon as a child with suspected DKA is admitted – *remember children can die during DKA.* Mortality may be due to cerebral oedema which is unpredictable or hypokalaemia or aspiration pneumonia which are preventable.

Guidelines for use of this ICP

The pathway provides the documentation for both medical and nursing records, it is not a rigid document and clinicians may use their own professional judgement as appropriate, recording as a variance any alterations to the practice outlined or any deviation from the expected plan.

All sections should be *fully* completed.

Documentation of the patient's history and clinical assessment should be on the generic sheets.
Please note that IV fluids and Drugs should be prescribed on the generic In-Patient Medication Administration Record.
An online calculator for IV fluid administration and Sodium correction (in DKA) is also available via

http://www.bsped.org.uk/clinical/docs/DKACalculator2015.pdf

AND

http://www.strs.nhs.uk/resources/pdf/guidelines/correctedNA.pdf

It is *essential* that all staff using the pathway complete the 'signature key box' (pg 6). This ensures that those using the pathway can be identified. You can then use your initials in the pathway instead of full signature and printed name.

Please ensure all entries are initialled, dated and timed.

Please only use abbreviations in the Pathway if they are on the list of approved abbreviations on page 31 of the document.

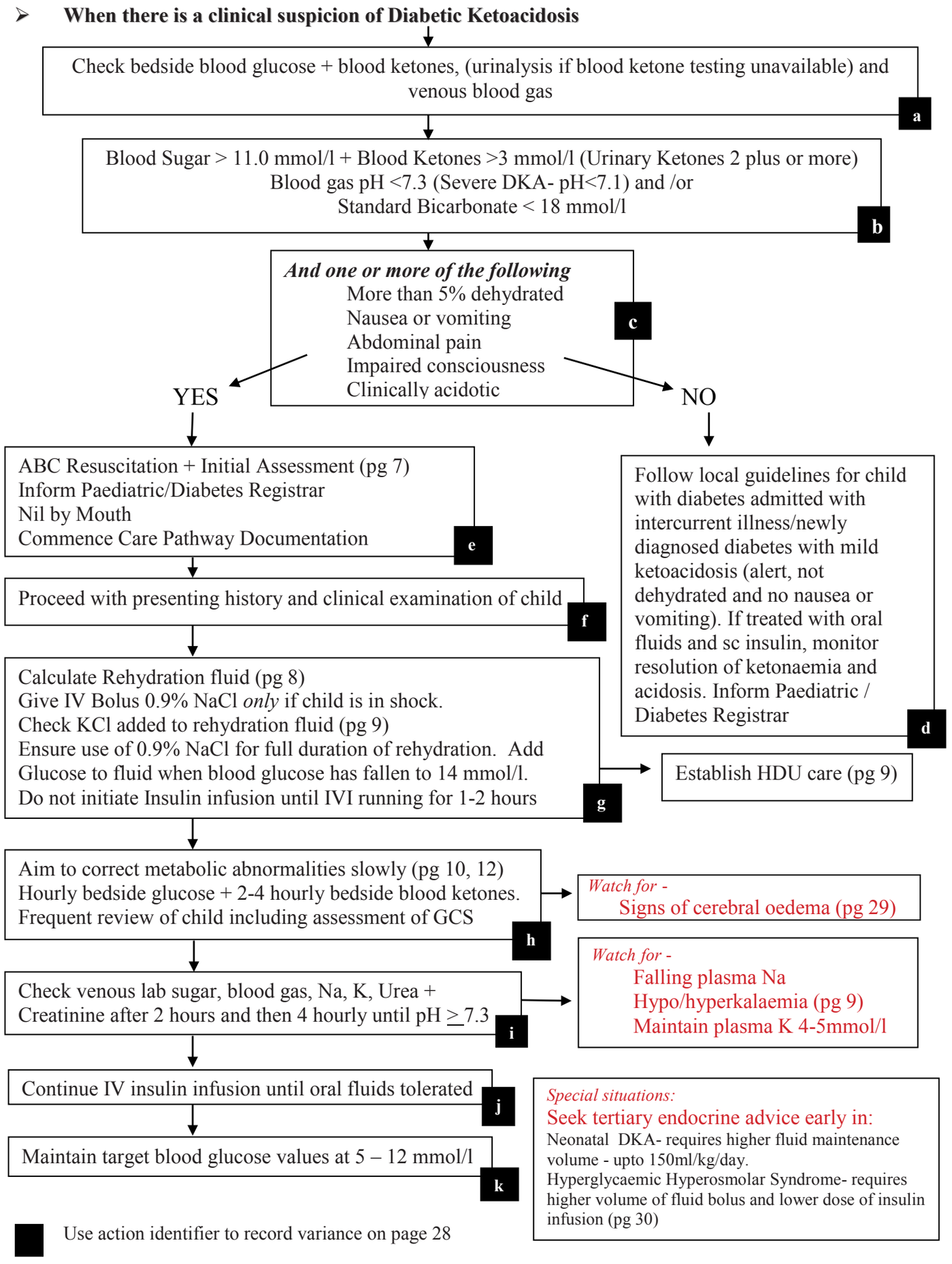
Variations from the ICP should be documented on the Variance sheet (Pg 28). Any problems that may be encountered should be documented on the Problem sheet (Pg 28). Any comments about the ICP are welcomed (Pg 28).

INDEX

	Page
INTEGRATED CARE PATHWAY FLOW CHART	5
SIGNATURE AND INITIALS	6
PATIENT ASSESSMENT AND INVESTIGATIONS –first hour (Triage, sheets to be completed by A+E/Children's Assessment Unit)	7
INTRAVENOUS FLUIDS	
▪ Initial	8
▪ Potassium	9
▪ Insulin	9
ONGOING REVIEW - Biochemistry	10
RESULTS SHEET	11
ONGOING REVIEW – Fluids	12
DAILY RECORD	
▪ High Dependency Nursing Care	13 ■
▪ Intensive Monitoring Chart	14, 16, 18 ■
▪ Intake/Output Chart (Includes all IV fluids)	15, 17, 19 ■
CONTINUATION SHEETS	20 – 26
CONTINUING CARE	
▪ Fluids and Insulin	27 ■
VARIANCE / PROBLEMS / COMMENTS SHEET	28
APPENDIX 1- Management of Cerebral Oedema	29
APPENDIX 2- Management of Acidosis	30
APPENDIX 3- Hyperglycaemic Hyperosmolar Syndrome	30
CONTACT TELEPHONE NUMBERS	31
ABBREVIATIONS	31
REFERENCES / RESOURCES	31

■ = Page includes primarily Nursing Documentation

DIABETIC KETOACIDOSIS INTEGRATED CARE PATHWAY FLOW CHART



Signature Sheet

It is *essential* that all staff using the pathway complete the 'signature key box' below, this ensures that those using the pathway can be identified. You can then use your initials in the pathway instead of full signature and printed name.

Print Name	Designation	Work Area	Initials	Signature	Date

ICP: Diabetic Ketoacidosis **Dr Initials_____ Date_____**
Nurse Initials_____Date_____

Initial Clinical Assessment ABCD		**[a, b, c,e,f]**
Patient presented to A&E /Children's Assessment Unit at ☐☐ :☐ ☐ hours		
Observations on Admission		
Airway Patent Y ☐ N ☐	NG tube if vomiting or drowsy (stomach may be dilated and aspiration can be fatal) Y ☐ N ☐	
Breathing Respirations /min	SaO_2 ☐ % Give O_2 to maintain $SaO_2 > 95\%$ Y ☐ N ☐	
Acidotic Respiration Y ☐ N ☐	Temperature ☐ °C	
Circulation Pulse /min	Capillary return time secs	
BP mmHg	Shock? Y ☐ N ☐ Consider IV bolus (see page 8)	
Dehydration	Mild - Moderate (5%) [pH ≥ 7.1] ☐ Severe (10%) [pH < 7.1] ☐	
Remember it is difficult to accurately assess dehydration based on clinical status alone due to the effect of acidosis on peripheral circulation. Assume degree of dehydration based on pH.		
Disability (Neurology)	GCS ☐ /15 (see below)	AVPU ☐ (Alert, Responds to Voice, or Pain, or Unresponsive)
Signs of Cerebral Oedema (headache, irritability, drowsiness, focal neurology, low pulse rate, high BP, pupil inequality/dilatation, papilloedema)? Y ☐ N ☐ If YES: Seek urgent anaesthetic review. Give Hypertonic (2.7% or 3%) saline (2.5-5 ml/kg IV over 10-15 minutes) *OR* Mannitol 20% (2.5-5 ml/kg IV over 10-15 minutes). (See Appendix 1, page 29 for further management)		
Glasgow Coma Score (GCS) Maximum score 15, minimum score 3		

Best Motor Response	1= none 2= extensor response to pain 3= abnormal flexion to pain 4= withdraws from pain 5= localises pain 6= responds to commands	Best Verbal Response	1= none 2= incomprehensible sounds 3= inappropriate words 4= appropriate words but confused 5= fully orientated	Modification (2-5yrs) 1= none 2= grunts 3= cries or screams 4= monosyllables 5= words of any sort
Eye Opening	1= none 2= to pain 3= to speech 4= spontaneous		Modification (<2yrs) 1= none 2= grunts 3= inappropriate crying/unstimulated screaming 4= cries only 5= appropriate non-verbal responses (coos, smiles, cries)	

Bedside blood glucose mmol/l	Bedside blood ketones mmol/l
If blood ketones cannot be tested - Ketonuria Small☐ Moderate☐ Large ☐	

- ***Document subsequent observations on Page 12***
- ***Obtain IV Access***

Immediate Bloods (Please tick)				**Additional Bloods – in newly diagnosed patient** (Please tick)			
Plasma Glucose		FBC		FT_4, TSH		Anti-GAD antibodies	
Venous Blood Gas		U+E s		Anti-thyroid antibodies		C-Peptide (Type 2 DM)	
Blood Cultures		CRP		IgA		*Other*	
HbA_{1c}		Urine C+S		Anti-tTG antibodies			

- **Inform Paediatric/Diabetes Registrar/Consultant on Call of Admission**

Other Measures	
I.V. Ranitidine 1mg/kg T.I.D. if NG aspirate is positive for blood	Yes☐ No☐

Confirmed Ketoacidosis: Treatment

- **Fluids** ***Document all fluids carefully. Show calculations and tick as applicable*** **[g]**

Consider IV bolus *only* if child is shocked (rapid, thready pulse, very poor peripheral perfusion).
Fluid bolus is *not recommended* in mild or moderate dehydration (pH ≥ 7.1).
Fluid bolus is *not routinely recommended* even if pH<7.1. Seek senior advice if unsure.

Move to section below for Dehydration Correction, if child is not in shock.

➢ **IV Bolus required?** **Yes** ☐ **No** ☐

Use 0.9% Saline: **10ml/kg** as rapid IV bolus.

Weight of Child = _____ kg (Actual ☐ / Estimated ☐ / Recent Clinic ☐)

Volume of fluid bolus = _____ (Weight in kg) x 10 = _____ ml

Action- Fluid bolus prescribed (on In-patient Medication Administration Record)

Dr Initials_____ Date_____ Time _____

➢ **Was there a clinical response to the initial bolus?** **Yes** ☐ **No** ☐

If the response to initial bolus was inadequate, consider further bolus of 10ml/kg 0.9% Saline after discussion with a senior paediatrician. (Maximum 0.9% Saline bolus – 30 ml/kg)

Action- *Second* Fluid bolus prescribed (on In-patient Medication Administration Record)

Dr Initials_____ Date_____ Time _____

➢ Correct dehydration *based on pH* with 0.9% saline as calculated below.
To avoid overzealous fluid replacement (which may be a risk factor for cerebral oedema Appendix 1, pg 27)

- Calculate deficit according to % dehydration. Estimate dehydration *based on pH*. **Never assume child is more than 10% dehydrated.**
- Subtract only IV bolus volumes given in excess of 20ml/kg (rarely required) from the total fluid calculation

Aim to correct dehydration over 48 hours (this is simple and safe)

Normal fluid requirements: Use 0.9% Saline

Body Weight	Fluid requirement per 24hr	**Show calculation**
<10 kg	2 ml/kg/hr	_____ ml *x* _____kg *x* 24hr
10-40 kg	1 ml/kg/hr	
>40 kg	40 ml/hr	
Total 24 hr maintenance		= _____ ml
Therefore total 48 hr maintenance		_____ *x* 2 = _____ ml

E.g. A 6 year old child weighing 20 kg who is 10% dehydrated (pH<7.1) & needed 30 ml/kg saline bolus, will require
1 ml *x* 20 kg *x*24 = 480 ml maintenance each 24 hours
480 ml *x* 2 = 960 ml for 48 hours
plus 10 % *x* 20 kg = 2000 ml deficit
= 2960 ml
minus bolus in excess of 20ml/kg (30-20ml/kg)
10 ml *x* 20 kg = 200 ml
i.e. 2760 ml over 48 hours = 57 ml/hour

Deficit (in ml) = % dehydration *x* weight (in kg) *x* 10 **Deficit** = ☐ **ml**

Correction over 48 hours:

Hourly infusion rate = (48 hr Maintenance ☐ +Deficit ☐ −Fluid bolus over 20ml/kg ☐) / 48

= ☐ **ml/hr**

Action – Fluids prescribed (on In-patient Medication Administration Record)
Dr Initials_____ Date_____ Time _____
- Calculation checked **Dr Initials_____ Date_____ Time _____**

ICP: Diabetic Ketoacidosis

Potassium

- Following resuscitation, commence potassium immediately in rehydration fluid unless anuria is suspected.
- There is always massive depletion of total body potassium, although initial plasma levels may be low normal, or even high. Levels in the blood will fall once insulin is commenced.
- 0.9% saline containing 40mmol/l of KCl is recommended as the rehydration fluid. Continue 0.9% saline for at least 12 hours.
- Alter potassium replacements as required, to maintain plasma potassium 4–5 mmol/l. (Use a cardiac monitor and observe frequently for T wave changes.)
- If hypokalaemia develops (potassium<3mmol/l), consider temporarily suspending insulin infusion. Discuss with PICU as a central line is needed for potassium containing solutions >40mmol/l.

Action – Confirm that initial Rehydration Fluid contains 40 mmol/l of KCl **Dr Initials_____ Date _____ Time _____**

Insulin

- Do not start insulin infusion until correction of shock is complete and IV fluids have been running **for at least one - two hours**.
- The recommended rate of infusion (that aims to switch off ketogenesis) is 0.05-0.1unit/kg/hour. *Start infusion at 0.05unit/kg/hour.* If blood ketones are not falling after 6-8 hr, increase the insulin infusion to 0.1unit/kg/hour.

Make up 50 units (0.5ml) Actrapid to 50 ml with 0.9% saline → 1unit of insulin/ml.

Amount of insulin prescribed = 0.05unit *x* _____weight (kg)/hour
= _____unit/hour
= _____ml/hour of the insulin solution

Action – Insulin prescribed (on In-patient Medication Administration Record) **Dr Initials_____ Date _____ Time _____**

- Children with pre-existing diabetes who are on a long acting analogue e.g. Insulin Glargine (Lantus) / Insulin Detemir (Levemir) may continue on their usual dose at the usual time, subcutaneously, in addition to the IV insulin infusion throughout the episode of DKA (discuss with consultant)
- For children on continuous subcutaneous insulin infusion (CSII) pump therapy, stop the pump when starting DKA treatment

- Transfer to HDU
- Consider liaison / transfer to PICU
  - If child has severe persistent acidosis (pH < 7.1) with marked hyperventilation (For metabolic acidosis see Appendix 2 on page 30)
  - If child has severe dehydration with shock (discuss the use of inotropes)
  - If child has depressed sensorium with risk of aspiration from vomiting
  - If child is very young (under 2 years)
  - If staffing levels on the wards are insufficient to allow adequate monitoring
- Seek urgent anaesthetic review if child is unconscious

N.B. Terminate use of the Care Pathway in any child requiring Intensive Care. Consider use of anticoagulant prophylaxis in young children if the usual contraindications do not apply, especially if femoral lines are inserted.

ICP: Diabetic Ketoacidosis

For management of Cerebral Oedema and Metabolic Acidosis, refer Appendices 1 & 2 on Pages 29-30.

Suspect sepsis if any of the following:

- Fever or hypothermia
- Hypotension
- Refractory acidosis
- Lactic acidosis

FREQUENT REVIEW OF CHILD NECESSARY	
BIOCHEMISTRY	[i]

- Carry out a clinical review and re-check laboratory glucose, U+E s and capillary / venous blood gas **after 2 hours and then 4 hourly** until blood pH ≥ 7.3
- Check bedside blood ketones 2-4 hourly
- Watch for hypokalaemia –**aim to keep plasma potassium 4 – 5 mmol/l** (If >20 mmol/500ml is required- **this may need central access**).
- Plasma sodium should **rise** as DKA is treated. Persistently low or falling plasma sodium should raise a suspicion of developing cerebral oedema.

NB Hyperglycaemia may cause spuriously low plasma sodium level due to osmolar dilution by glucose and sodium-free lipid fraction.
Corrected Na (i.e. for normal glucose level) = Measured Na + 0.4(Measured glucose - 5.5)

- An online calculator is also available via http://www.strs.nhs.uk/resources/pdf/guidelines/correctedNA.pdf

Action: Clinical review and blood ketones, laboratory glucose, capillary / venous blood gas, U+E s re-checked after 2 hr

Dr Initials_____ **Date**_____ **Time** _____

Action Clinical review and venepuncture 4 hourly (or earlier if necessary)					
Initials:	Date:	Time:	Initials:	Date:	Time:
Initials:	Date:	Time:	Initials:	Date:	Time:
Initials:	Date:	Time:	Initials:	Date:	Time:
Initials:	Date:	Time:	Initials:	Date:	Time:
Initials:	Date:	Time:	Initials:	Date:	Time:
Initials:	Date:	Time:	Initials:	Date:	Time:
Initials:	Date:	Time:	Initials:	Date:	Time:
Initials:	Date:	Time:	Initials:	Date:	Time:

A medical face to face review must be carried out at diagnosis and at least every 4 hr thereafter. *More frequent review* is indicated if child is <2 yr, severe DKA or any other special concern. At each review assess

- Clinical status, vital signs and neurological status
- Results of blood investigations
- ECG trace
- Cumulative fluid balance record

ICP: Diabetic Ketoacidosis

RESULTS SHEET

DATE									
TIME									
Dr Initials									
Na									
Corr Na									
K									
Chloride									
Urea									
Creatinine									
Glucose									
pH									
pO_2									
pCO_2									
Base excess									
Standard Bicarbonate									
Hb									
Hct									
WCC									
Neutrophils									
Lymphocytes									
Monocytes									
Platelets									
CRP									
HbA_{1c}									
FT4									
TSH									
Microbiology									

FREQUENT REVIEW OF CHILD NECESSARY	
FLUIDS	[h, j, k]

- **Aim for a fall of glucose not >8 mmol/l/hr**

When blood glucose falls to <14 mmol/l or rate of fall >8 mmol/l/hr, add dextrose to the fluid (0.9% saline + 5% dextrose). Continue with added potassium as described above (ref: pg 9)

Action:- sign when changing to 0.9% saline / 5 % dextrose (with 40mmol/l potassium chloride)

Dr Initials_____ **Date**_____ **Time** _____

If there is a rise in blood glucose again >14 mmol/l, **DO NOT** change the fluid back to one without dextrose. If this rise in blood glucose is sustained check that insulin is infusing at the prescribed rate. Use near patient blood ketone testing to confirm that ketone levels are falling adequately. If there is no decrease within 6-8 hr, consider increasing insulin dosage to 0.1unit/kg/hr.

Action:- sign when increasing the insulin infusion rate to 0.1 units/kg/hour

Dr Initials_____ **Date**_____ **Time** _____

If IVI running already contains 5% dextrose, blood glucose < 6 mmol/l and rate of fall > 8 mmol/l/hour, consider:
Changing to 0.9% saline + 10% dextrose (with 40mmol/l potassium chloride)

OR

If insulin infusion is running at 0.1 unit/kg/hr), consider reducing insulin infusion back to 0.05 unit/kg/hr ***providing ketone levels are falling steadily***.

OR Both

Do **not** reduce the insulin infusion to < 0.05 unit/kg/hr.

Action:- sign when changing to 0.9% saline + 10% dextrose (with 40mmol/l potassium chloride)

Dr Initials_____ **Date**_____ **Time** _____

AND/ OR

Action:- sign when reducing insulin infusion rate to 0.05 unit/kg/hr

Dr Initials_____ **Date**_____ **Time** _____

If blood glucose <4 mmol/l, give 2 ml/kg 10% dextrose and commence 0.9% saline/10% dextrose with added potassium.

Action:- sign when giving 2 ml/kg of 10% dextrose

Dr Initials_____ **Date**_____ **Time** _____

- If there is a sustained rise of blood sugar and / or persisting acidosis consider -
  - Insufficient insulin to switch off ketones - Check that insulin is infusing at the prescribed rate
  - Inadequate initial resuscitation
  - Need to replace significant on-going fluid losses
  - Sepsis
  - Hyperchloraemic acidosis (refer Appendix 2 on pg 30)

Discuss further management with consultant.

Remember to sign Signature Sheet

ICP: Diabetic Ketoacidosis

High Dependency Unit – Nursing Care						
Nursing staff are responsible for implementing the following care. During each shift tick the appropriate box with initials and date below. Document action taken below.						
	Day 1	Night 1	Day 2	Night 2	Day 3	Night 3
Neurological Observations ▪ ½ hourly ▪ 1 hourly as indicated Report changes immediately Report severe headache at any time						
BP + TPR + O_2 saturation : ▪ ½ hourly (in children < 2 yr and severe DKA) ▪ 1 hourly as indicated Report changes immediately						
Bedside Glucose hourly						
Bedside Blood ketone 2-4 hourly						
Contact medical staff if K+ ≥ 6.5 mmol/l.						
N/G tube on free drainage and aspirate hourly						
Nil by Mouth (until ketosis improves and blood ketones <1 mmol/l)						
Hourly recording of intake and urine output. Consider urinary catheterisation if accurate measurement of urine output is not possible.						
Record insulin infusion hourly Change infusion after 12 hours						
Explain all care and treatment to parents and child						
Provide play activities						
Document additional action taken						

Intensive Monitoring Chart (Diabetes)

Frequency Requested ½ hrly_____ 1 hrly _____ 2 hrly_____ 4hrly_____ 6hrly_____
(Please circle and date + time changes)

DATE													
TIME													
INITIALS													
x RESPS breaths/min		**• TEMP** °C	41										
	220		40										
	210		39										
	200		38										
	190		37										
	180		36										
	170		35										
	160												
o PULSE beats/min	150												
	140												
	130												
	120												
	110												
	100												
< BLOOD PRESSURE mm Hg	90												
	80												
	70												
	60												
	50												
	40												
	30												
	20												
	10												
	Mean BP												
Bedside Blood Glucose													
Bedside Blood Ketones													
Urinalysis:Glucose													
Urinalysis:Ketones													
SaO_2													
Oxygen %													
GCS	Motor												
	Verbal												
	Eye												
	Total												
ORAL CARE													

Name
DOB
Affix Patient Identity Label
HOSP NO
NHS NUMBER

Intake/Output Chart

➢ ALL IV FLUIDS AND MEDICATION MUST BE PRESCRIBED ON THE **IN-PATIENT MEDICATION ADMINISTRATION CHART**

DATE													
TIME													
INITIALS													
INPUT	**Type of Fluid** vol												
	rate												
	Type of Fluid vol												
	rate												
	Type of Fluid vol												
	rate												
	Type of Fluid vol												
	rate												
	Hourly TOTAL IV Fluids IN												
	Hourly ORAL IN												
INSULIN	INSULIN (units/kg/hr)												
	Rate of Infusion (ml/hr)												
	Volume Given (ml)												
	Volume Left (ml)												
	Change insulin Infusion 12 hrly												
Hourly TOTAL IN													
Cumulative TOTAL IN (A)													
OUTPUT	PU (ml)												
	BO												
	VOMIT												
	NG ASPS (ml)												
Hourly TOTAL OUT													
Cumulative TOTAL OUT (B)													
Cumulative FLUID BALANCE (A-B)													
Pump Pressure (Insulin)													
Pump Pressure (IVI)													

IV ACCESS OBTAINED (apply AMETOP)		YES ☐	NO ☐	
IV ACCESS	Size	Site	Time	Initials
If No specify alternative route				
IV ACCESS OBTAINED (apply AMETOP)		YES ☐	NO ☐	
IV ACCESS	Size	Site	Time	Initials

Intensive Monitoring Chart (Diabetes)

Frequency Requested ½ hrly_____ 1 hrly _____ 2 hrly_____ 4hrly_____ 6hrly_____
(Please circle and date + time changes)

DATE													
TIME													
INITIALS													
x RESPS breaths/min	• TEMP °C												
220	41												
210	40												
200	39												
190	38												
180	37												
170	36												
160	35												
150													
140													
130													
120													
110													
100													
90													
80													
70													
60													
50													
40													
30													
20													
10													
< BLOOD PRESSURE mm Hg ° PULSE beats/min	Mean BP												
Bedside Blood Glucose													
Bedside Blood Ketones													
Urinalysis:Glucose													
Urinalysis:Ketones													
SaO_2													
Oxygen %													
GCS	Motor												
	Verbal												
	Eye												
	Total												
ORAL CARE													

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Intake/Output Chart

➢ ALL IV FLUIDS AND MEDICATION MUST BE PRESCRIBED

IN-PATIENT MEDICATION ADMINISTRATION CHART

TIME													
INITIALS													
INPUT	**Type of Fluid** vol												
	rate												
	Type of Fluid vol												
	rate												
	Type of Fluid vol												
	rate												
	Type of Fluid vol												
	rate												
	Hourly TOTAL IV Fluids IN												
	Hourly ORAL IN												
INSULIN	INSULIN (units/kg/hr)												
	Rate of Infusion (ml/hr)												
	Volume Given (ml)												
	Volume Left (ml)												
	Change insulin Infusion 12 hrly												
Hourly TOTAL IN													
Cumulative TOTAL IN (A)													
OUTPUT	PU (ml)												
	BO												
	VOMIT												
	NG ASPS (ml)												
Hourly TOTAL OUT													
Cumulative TOTAL OUT (B)													
Cumulative FLUID BALANCE (A-B)													
Pump Pressure (Insulin)													
Pump Pressure (IVI)													

IV ACCESS OBTAINED (apply AMETOP)		YES ☐	NO ☐	
IV ACCESS	Size	Site	Time	Initials
If No specify alternative route				
IV ACCESS OBTAINED (apply AMETOP)		YES ☐	NO ☐	
IV ACCESS	Size	Site	Time	Initials

Intensive Monitoring Chart (Diabetes)

Frequency Requested ½ hrly_____ 1 hrly _____ 2 hrly_____ 4hrly_____ 6hrly_____
(Please circle and date + time changes)

DATE													
TIME													
INITIALS													
x RESPS breaths/min													
• TEMP °C	41												
	40												
	39												
	38												
	37												
	36												
	35												
o PULSE beats/min	220												
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	190												
	180												
	170												
	160												
	150												
	140												
	130												
	120												
	110												
	100												
< BLOOD PRESSURE mm Hg	90												
	80												
	70												
	60												
	50												
	40												
	30												
	20												
	10												
	Mean BP												
Bedside Blood Glucose													
Bedside Blood Ketones													
Urinalysis:Glucose													
Urinalysis:Ketones													
SaO_2													
Oxygen %													
GCS	Motor												
	Verbal												
	Eye												
	Total												
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	DATE												
TIME													
INITIALS													
INPUT	**Type of Fluid** vol												
	rate												
	Type of Fluid vol												
	rate												
	Type of Fluid vol												
	rate												
	Type of Fluid vol												
	rate												
	Hourly TOTAL IV Fluids IN												
	Hourly ORAL IN												
INSULIN	INSULIN (units/kg/hr)												
	Rate of Infusion (ml/hr)												
	Volume Given (ml)												
	Volume Left (ml)												
	Change insulin Infusion 12 hrly												
Hourly TOTAL IN													
Cumulative TOTAL IN (A)													
OUTPUT	PU (ml)												
	BO												
	VOMIT												
	NG ASPS (ml)												
Hourly TOTAL OUT													
Cumulative TOTAL OUT (B)													
Cumulative FLUID BALANCE (A-B)													
Pump Pressure (Insulin)													
Pump Pressure (IVI)													

IV ACCESS OBTAINED (apply AMETOP)		YES ☐	NO ☐	
IV ACCESS	Size	Site	Time	Initials
If No specify alternative route				
IV ACCESS OBTAINED (apply AMETOP)		YES ☐	NO ☐	
IV ACCESS	Size	Site	Time	Initials

ICP: Diabetic Ketoacidosis

CONTINUATION SHEET- TO BE USED BY ANY TEAM MEMBER FOR DOCUMENTATION / NOTE-KEEPING DURING THE PATHWAY		
Date/Time		**Initials**

ICP: Diabetic Ketoacidosis

CONTINUATION SHEET- TO BE USED BY ANY TEAM MEMBER FOR DOCUMENTATION / NOTE-KEEPING DURING THE PATHWAY.		
Date/Time		**Initials**

ICP: Diabetic Ketoacidosis

CONTINUATION SHEET- TO BE USED BY ANY TEAM MEMBER FOR DOCUMENTATION / NOTE-KEEPING DURING THE PATHWAY		
Date/Time		**Initials**

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Continuing Care [k] Nursing staff are responsible for implementing the following care. Tick the appropriate box with initials, date and time below.			
	Date	**Time**	**Initials**
FLUIDS:			
▪ Remove NG tube when bowel sounds present			
▪ Oral fluids as tolerated from 12-18 hours onward if pH ≥ 7.3 and blood ketones <1mmol/l / urinary ketones are moderate or less. IVI rate should be reduced as oral intake increases.			
▪ Discontinue IV fluids when child is clinically rehydrated, eating and drinking and blood ketones <0.6mmol/l, even if calculated IV rehydration incomplete			
INSULIN:			
▪ Administer SC insulin as prescribed (according to local protocol) once blood ketones <0.6mmol/l and **FEED CHILD.**			
▪ Discontinue IV insulin 30 minutes after sc insulin is administered. For child on a pump restart pump 60 min before stopping IV insulin. Ensure change of insulin cartridge and infusion set and insertion of cannula into new SC site.			
Additional Comment **Re: Food prior to discharge to ward**			
▪ Ensure appropriate meal with carbohydrate content given			
▪ Child fit for transfer to ward			
▪ Child and family informed of transfer			
▪ Ward informed of transfer			
▪ Date and time discharged to ward			
▪ Actual weight on discharge to ward ____kg			

➢ ***The Integrated Care Pathway is now complete.***
Proceed to local protocol for ongoing care.

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VARIANCE

Action	Date	Time	Signature	Professional Code	Variance code	Comments

Action: The letter in the flow chart (Pg5) represents an action identifier. If the comment does not relate to a specific action in the chart a code is not used.

Professional Code: 1. Patient 2. Doctor 3. Registered Nurse 4. Pharmacist 5. Dietitian 6. Other (please specify)

Variance Code: 1. Clinical Judgement 2. System /operational failure 3. Patient choice 4. Other (please state)

Comments: All comments relating to actions are included in this area

COMMENTS / PROBLEMS

TO BE COMPLETED BY ANY TEAM MEMBER DURING THE PATHWAY		
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MANAGEMENT OF CEREBRAL OEDEMA

Watch for signs and symptoms of:

- Headache
- Slow pulse
- Change in neurological status (irritability, increased drowsiness, fits, incontinence)
- Plasma sodium falling (Check 4 hourly)
- Poor urine output (catheterise if not passed urine by 4 hours)
- Increased BP, reduced O_2 saturation, abnormalities of breathing pattern
- Specific neurological signs - cranial nerve palsies, pupillary inequality or dilatation, abnormal posturing, papilloedema (late sign)
- Exclude hypoglycaemia
- **Give Hypertonic (2.7% or 3%) saline (2.5-5 ml/kg IV over 10-15 minutes) or MANNITOL 20% (2.5-5 ml/kg IV over 10-15 minutes)**
  In order to have any effect, treatment needs to be given within 5-10 minutes of diagnosis of cerebral oedema.
- **Inform Paediatric Consultant on call and local Intensive Care Team immediately.**
  Restrict IV fluids to 1/2 maintenance and consider replacing fluid deficit over 72 hrs
  Initiate transfer to Intensive Care Unit for intubation and controlled ventilation
  (Aim for pCO_2 of 4-5kPa)
  Discuss with PICU staff and arrange retrieval by PICU team
  Consider need for additional MANNITOL after 2 hours if no response

Action: – Give hypertonic saline or mannitol (Show calculations)

Saline 2.7% 2.5 ml x _____ weight (kg) = _____ml over 10 minutes IV

OR

Mannitol 20% 2.5 ml x _____ weight (kg) = _____ml over 10 minutes IV

Dr Initials_____ Date_____ Time _____

Action:- Show fluid restriction calculation

24 hr maintenance = [ ] ml × 1/2 = New 24 hr maintenance [ ] ml
(Ref: Pg 8)

Hence new 72 hr maintenance = ml

Deficit replacement = ml

Therefore, new hourly fluid rate = $\frac{\text{New 72 hr maintenance + Deficit}}{72}$

=_____ml/hr

Dr Initials_____ Date_____ Time _____

Action: - Discuss with ITU Staff

Dr Initials_____ Date_____ Time _____

If the course of diabetic ketoacidosis is complicated by cerebral oedema terminate the use of this Integrated Care Pathway.

MANAGEMENT OF ACIDOSIS

Bicarbonate

There is no experimental evidence to support the use of bicarbonate in the treatment of metabolic acidosis in DKA

Remember

- Acidosis will almost always correct with correction of fluid balance and insulin administration
- Do not worry if acidosis is only correcting slowly. Remember pH is a log scale and so small improvements in pH are significant
- Persisting acidosis is usually due to insufficient resuscitation, insufficient insulin or hyperchloraemia (not clinically important)

  Consider the following options
  - giving crystalloid (a further bolus of 10-20 ml/kg of 0.9% saline)
  - starting inotropes if haemodynamically unstable
  - increasing the rate of insulin infusion
  - check blood ketones falling appropriately – suggests hyperchloraemic rather than ketoacidosis
  - the possibility that the child is septic

DO NOT USE BICARBONATE as it may increase the risk of cerebral oedema

➢ **AIM TO CORRECT METABOLIC ABNORMALITIES SLOWLY. TOO RAPID REVERSAL MAY CAUSE CEREBRAL OEDEMA WITH SIGNIFICANT MORTALITY**

Action – Further bolus of 0.9% Saline given

Dr Initials **Date** **Time**

Action – Use of Inotropes discussed with Consultant

Dr Initials **Date** **Time**

Appendix 3

HYPERGLYCAEMIC HYPEROSMOLAR SYNDROME

This is much less common than DKA and may be more often associated with Type 2 Diabetes Mellitus. Symptoms are more subtle and profound dehydration is associated with extreme elevation of blood glucose. It has a high mortality rate.

Criteria for diagnosis:

- Blood sugar ≥40 mmol/l
- Venous pH >7.3
- Serum bicarbonate >15 mmol/l
- Mild ketonuria, absent to mild ketonaemia
- Serum osmolality ≥320 mmol/kg
- Altered consciousness (obtundation/combativeness) or seizures

➢ Seek tertiary endocrinology advice early.

Principles of therapy include:

- Early restoration of intravascular and extravascular volume and normal renal perfusion requiring larger volumes for resuscitation and rehydration than used in management of DKA.
- K replacement once renal function is adequate.
- Insulin therapy should be initiated at a lower dose than in DKA and later in the course of rehydration, based on rate of fall of blood glucose levels.

(for further information, please refer to the *BSPED Recommended Guideline for the Management of Children and Young People under the age of 18 years with Diabetic Ketoacidosis 2015)*

Contact Telephone Numbers for Team

Name	Telephone Number	Pager Number / Bleep Number

Abbreviations used in this document

A+E	**Accident and Emergency**	**IV**	**Intravenous**
ABC	**Airway Breathing Circulation**	**IVI**	**Intra venous Infusion**
Anti-GAD	**Anti Glutamic Acid Decarboxylase**	**K**	**Potassium**
BE	**Base Excess**	**KCl**	**Potassium Chloride**
BP	**Blood Pressure**	**LFT**	**Liver Function Tests**
CRP	**C Reactive Protein**	**Na**	**Sodium**
CNS	**Central Nervous system**	**NaCl**	**Sodium Chloride**
CO_2	**Carbon Dioxide**	**NG**	**Nasogastric**
C+S	**Culture and Sensitivity**	**O_2**	**Oxygen**
DKA	**Diabetic Ketoacidosis**	**PICU**	**Paediatric Intensive Care Unit**
FBC	**Full Blood Count**	**SaO_2**	**Oxygen Saturation**
FT4	**Free Thyroxine**	**SC**	**Subcutaneous**
GCS	**Glasgow Coma Scale**	**TSH**	**Thyroid Stimulating Hormone**
Hb	**Haemoglobin**	**U+E**	**Urea and Electrolytes**
HbA_{1c}	**Glycated Haemoglobin**	**VBG**	**Venous Blood Gas**
Hct	**Haematocrit**	**WCC**	**White Cell Count**
HDU	**High Dependency Unit**		

Diabetic Ketoacidosis ICP References/Resources

1. NICE guideline August 2015, *nice.org.uk/guidance/ng18*.
2. BSPED Recommended Guideline for the Management of Children and Young People under the age of 18 years with Diabetic Ketoacidosis 2015.
3. ESPE/LWPES consensus statement on diabetic ketoacidosis in children and adolescents. Dunger et al, *Archives of Disease in Childhood*, 2004;89 (2):188-194).
4. ISPAD Clinical Practice Consensus Guidelines 2014 Compendium: Diabetic ketoacidosis and hyperglycaemic hyperosmolar state.
5. BNF for Children, 2015-2016.

DIABETIC KETOACIDOSIS IN CHILDREN INTEGRATED CARE PATHWAY